Visually directed HIFU for prostate cancer – a new standard

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Introduction

Trans-rectal High Intensity Focused Ultrasound (HIFU) is a non-invasive ablation therapy that has been used for the treatment of organ confined prostate cancer[1]. The majority of published series have reported the results of devices which have not permitted real time feedback to the operator during treatment[2]. Real time feedback has been cited as a key desirable attribute of ablation therapies[3]. We report the first description of the outcomes produced when real time grey scale feedback is used as the principal determinant of dose.

Methods

Eighteen men have been treated in 2005 with a minimum of 3 months follow-up. Three months is the minimum time required to measure the PSA nadir following treatment. One man had previously undergone transurethral resection of the prostate. None had previous hormone or 5-alpha reductase inhibitor therapy. Men received a single treatment session under general anaesthetic. The Sonablate-500® (Focus Surgery, IN, USA) was used in all cases (figure 1). Both imaging and treatment was carried out using a 4Mhz bi-plane, bi-concave probe (focal lengths 3 & 4cm) (figure 2). Grey scale changes were assessed during treatment and used to guide ultrasonic exposure parameters.

Figure 1 The Sonablate-500® device (a) Sonachill® cooling system, (b) probe on mobile gantry and (c) Ultrasound generator and control unit

Figure 2 Treatment screen, showing the transverse (a) and longitudinal (b) images of the prostate. Superimposed representations of 4cm (c) and 3cm (d) focal length transducers

Results: Demographic and Operative details

Are given in table 1.

	Mean	Range
Age (years)	62	50 - 75
PSA (ng/ml)	8.44	3.70 – 14.00
Gleason score	6	5 - 7
T stage	n/a	1 (n=12) – 2 (n=6)
Prostate volume (cm^3)	28	18 - 39
Operative time (min)	248	200 - 345

Table 2 Demographic and operative details

Efficacy

Fifteen patients treated have achieved PSA nadirs of 0.2ng/l or less, three months after treatment. Six patients have achieved undetectable PSA values. The mean operative time was 248 minutes (range 200 to 345). A detailed breakdown of results is given in table 1; risk stratification is given as High (red), Intermediate (yellow) and Low risk (green) according to D'Amico[4]

Patient number	PSA before HIFU (ng/ml)	PSA 3 months after HIFU (ng/ml)
1	13.70	0.80
2	5.00	0.08
3	11.30	0.08
4	10.00	0.10
5	3.70	0.06
6	8.10	0.27
7	10.50	0
8	13.00	0.05
9	14.00	0.06
10	8.10	0
11	4.41	0
12	4.00	0
13	6.31	0
14	9.30	0.13
15	5.40	0.60
16	12.00	0.16
17	8.40	0
18	4.68	0.1

Table 2 PSA nadirs for individual patients at 3 months

Toxicity

All patients were discharged the same day with an indwelling urethral catheter. Sixteen patients (89%) became catheter free at first attempt (mean 12 days, range 10 to 27).

No patients experienced grade 2 or 3 urinary incontinence or rectal injury.

Three men have required post procedural interventiaon – one urethral stricture requiring dilation, and two cystoscopic procedures to remove debris)

Discussion & Conclusions

Visually directed HIFU can achieve low PSA nadirs. In this small group of patients visually directed HIFU compares favourably with both brachytherapy and cryotherapy in the treatment of organ confined prostate cancer. PSA levels have fallen to 0.2ng/ml or less in 83% of cases and to an undetectable level in six patients.

Real-time grey scale changes were graded 1, 2 or 3 depending on whether hyperechoic regions were identified within individual treatment zones, became confluent between adjacent treatment zones, or were seen outside the treatment zone respectively. These 'Uchida changes' allowed us to alter the power of ultrasonic exposure throughout the therapy, tailoring treatment to the individual gland rather than basing exposure on a pre-defined algorithm. This quantification allowed comparison both in and between treatments and is a necessary step in the description of the conduct of therapy.

In these early days of a new modality it is essential that an attempt is made to understand the determinants of outcome. Low PSA nadirs may correlate to long term disease free survival as they do in surgery, radiotherapy and brachytherapy but it is only with greater patient numbers and longer follow up that this endpoint may be assessed.

There is a great deal of research currently underway into the real-time guidance of therapeutic ultrasound. Ultrasound thermometry[5], elastography[6] and magnetic resonance imaging[7] are all under assessment but are not in mainstream clinical use in the treatment of prostate cancer.

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